# AI 3401 TRACTORS AND ENGINE SYSTEMS

# **UNIT II NOTES**



#### **Governing System:**

The engine control device is called a governor. The governor can be mechanical or an electronic device. In general, governors for IC engines are of the centrifugal-force, spring loaded type.

A good governor for agricultural tractor engines is taken to be one giving performance such that the difference between no load speed and maximum load speed is less than 100 rpm. The maximum load and no, load are at maximum governor settings on both sides. As with the increase of load the crankshaft torque rises to a peak and that maximum torque is developed at a speed well below governed speed and therefore well below the speed at which maximum power is obtained. It is an important phenomenon. When the engine is operating at the full throttle, its speed and power are controlled solely by load and some reserve is provided by governor in order to cope with sudden increase of load. If at any particular speed of engine set by the operator, the increase or decrease in load will decrease or increase the speed is regulated by the governor without changing the gear. But a tractor fitted with a suitable diesel engine having more than 500 rpm in reserve that is the difference in maximum power speed and maximum torque speed, will possess good slogging ability.

#### Need for governor:

Governor is the device used to control the speed in engines. It is observed that when load is applied on the engine, the speed tends to decrease which is known as rpm drop also, to compensate the speed, governor is used in all stationary or mobile engines which run on either single speed or variable speeds. In general, following are the two operating systems being used in engines governors.

i) Hit and Miss system

#### ii) Throttle system

In hit and miss system, the frequency of cycles for fuel supply is controlled in the fuel system. Whereas, in throttle system, the frequency remains the same but the quantity of fuel is being controlled as per the engine requirements. Throttle system is the most commonly governing system being used in modern engines these days. The extent of throttle opening controls the fuel supply and hence the engine speed.

Although, the governor is used to maintain the constant engine speed, but still some variation in engine speed can be observed at no load and maximum load. This variation can be expressed in terms of Governor Regulation (%).

### Governor Regulation = (S0 + S1) / 2(S0 - S1) \* 100

Where, S0 = No Load speed

S1 = Maximum Load spped

The governors may be further classified as:

i. Centrifugal/Mechanical governor

ii. Pneumatic governor

iii. Hydraulic governor

### **Mechanical governor**

The centrifugal/mechanical governor is most commonly used governor in tractors. Two spring-loaded centrifugal weights are mounted on the governor shaft having sliding collar which further actuates the throttle and the fuel supply. As the engine speed increases, the weights fly apart with the centrifugal force against the spring tension to actuate fuel injection pump to reduce the amount of fuel delivered and hence decreases the engine speed. Similarly, the fuel supply is increased by the governor when the engine speed tends to decrease.

### **Pneumatic governor**

A pneumatic governor consists of venturi unit and diaphragm unit which are connected by a vacuum pump. The venturi unit leads to the engine inlet manifold and the diaphragm unit is connected with the fuel injection pump. The position of the butterfly valve in the venturi unit is controlled by the accelerator pedal to control the amount of vacuum from the inlet manifold, to actuate the fuel pump through diaphragm unit and hence the amount of fuel injected.

### Hydraulic governor

A hydraulic governor works on the principle of pressure change and receives the oil from the engine lubricating system which further act as controlling force to control the fuel supply and hence the engine speed. The loss of oil pressure cuts the supply of oil to the governor and cause the governor to shut down the engine.

### **Electrical system of Battery**

The electrical system is very important in the automobiles. Electricity flow through different systems in order to different object such as cranking, ignition, charging, lighting etc. Following are the electrical systems which are used in an automobiles:

1. Starting System: The system which helps in cranking to the engine for starting. The working com ponents in this systems as:

(a) Self-Starter

(b) Storage Battery

(c) Starting switch

2. Ignition System: To provide electric spark in combustion chambers to ignite fuel-air mixture at specific time in petrol engine. The working components in this systems as:

(a) Storage battery or magneto

(b) Ignition switch

(c) Ignition coil

(d) Distributor, in case of multi-cylinder engine

(e) Spark plugs and

() Ampere meter

3. Charging system: It help to charge the storage battery. The working components in this system as:

(a) Storage battery

(b) Dynamo or Alternator

(c) Ammeter

(d) Cutout and voltage regulator

4. Lighting System: This system provide current to different lights of the vehicle.

5. Horn System: By means of which blown an electric horn.

6. Miscellaneous components: Switches, Fuse and Junction Box, Wiper motor, Heater, Clock etc. We describe here only main electric components in this chapter:

## **Functions of Battery**

- To provide electrical power to start the engine. A battery's primary function is engine starting. ...
- To supply additional current when the charging system can't keep up with electrical demand. ...
- To act as a voltage stabilizer for the charging system.

### What is a Lead-acid Battery?

The Lead-acid battery is one of the oldest types of rechargeable batteries. These batteries were invented in the year 1859 by the French physicist Gaston Plante.

Despite having a small energy-to-volume ratio and a very low energy-to-weight ratio, its ability to supply high surge contents reveals that the cells have a relatively large power-to-weight ratio.

## **Chemical Reaction for Discharging**

When the battery is discharged, it acts as a galvanic cell and the following chemical reaction occurs.

### Negative:

 $Pb(s) + HSO_4^- + H_2O(l) \rightarrow 2e^- + PbSO_4(s) + H_3O^+(aq)$  (oxidation)

## **Positive:**

 $PbO_2(s) + HSO_4(aq) + 3H_3O(aq) + 2e^- -> PbSO_4(s) + 5H_2O(l)$  (reduction)

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Lead sulfate is formed at both electrodes. Two electrons are also transferred in the complete reaction. The lead-acid battery is packed in a thick rubber or plastic case to prevent leakage of the corrosive sulphuric acid.

## Lead Acid Battery Charging

The sulphuric acid existing in the lead discharge battery decomposes and needs to be replaced. Sometimes, the plates change their structure by themselves. Eventually, the battery becomes less efficient and should be charged or changed.



When r batteries spend considerable durations of time in their discharged states, the lead sulfate build-up may become extremely difficult to remove. This is the reason why lead-acid batteries must be charged as soon as possible (to prevent the building up of lead sulfate). Charging of the lead batteries is usually done by providing an external current source.

A plug is inserted which is linked to the lead-acid battery and the chemical reaction proceeds in the opposite direction. In cases where the sulphuric acid in the battery (or some other component of the battery) has undergone decomposition, the charging process may become inefficient. Therefore, it is advisable to check the battery periodically.

## Dyanamo

Dynamos and Generators **convert mechanical rotation into electric power**. Dynamo - a device that makes direct current electric power using electromagnetism. It is also known as a generator, however the term generator normally refers to an "alternator" which creates alternating current power.

Basic principle is electrical power is produced by electro-magnetic induction



A rectangular coil of wire is wound on an axis and is kept to rotate easily between the poles of magnet This rotating coil is called armature. This is wound over thin plates of soft iron to increase the strength of the magnetic field. The ends of the coil are in contact with split rings called commutator. Two carbon brushe are in contact with the commutator to collect the current produced by the armature. As the magnets b themselves are weak and create a weak field, field coils are taken from the brushes to strengthen the magneti field between the poles.

When the coil is made to rotate, the magnetic lines of force in the magnetic field are rapidly cut the voltage is generated. When a portion of the coil crosses the north pole, the magnetic lines of force are cu and the current is induced in one direction and when it crosses the south pole the current is induced in th opposite direction (Fig. 19.6). Since the same segment of the coil passes through both the poles alternatel the current changes the direction twice in the same conductor. So the current produced is alternating nature. But the current is made to flow in indirection by using commutator.

### **Details of Components**

The main components of dynamo are shown in Fig. 19.7 which are as under:

- 1. Armature assembly]
- 2. Field coils

### 3. Brushes

## 4. End shields and body

#### 5. Pole shoes

co assembly

